California High-Speed Train Project

TECHNICAL MEMORANDUM

High-Speed Train Station Platform Geometric Design
TM 2.2.4

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1	30 Jun 10	Incorporate additional HST station platform requirements and airflow effects for trains passing through stations on tracks adjacent to passenger platforms.

Note: Signatures apply for the latest technical memorandum revision as noted above.

Prepared by

for the California High-Speed Rail Authority

System Level Technical and Integration Reviews

The purpose of the review is to ensure:

- Technical consistency and appropriateness
- Check for integration issues and conflicts

System level reviews are required for all technical memorandums. Technical Leads for each subsystem are responsible for completing the reviews in a timely manner and identifying appropriate senior staff to perform the review. Exemption to the system level technical and integration review by any subsystem must be approved by the Engineering Manager.

System Level Technical Reviews by Subsystem:

System Level Technical Reviews by Subsystem:

Systems:	Signed document on file Richard Schmedes	4 May 10 Date
Infrastructure:	NOT REQUIRED Print Name	 Date
Operations:	Signed document on file Paul Mosier	25 Jun 10 Date
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TABLE OF CONTENTS

ABSTRACT

The California High-Speed Train Project (CHSTP) will provide high-speed train service in the State of California with proposed terminal stations in Sacramento, San Francisco, Anaheim, and San Diego. Intermediate stations will serve locations along the alignment. For much of the alignment, high-speed trains will operate along dedicated tracks with stations that exclusively serve high-speed train operations. There are locations where the high-speed rail line will operate adjacent to or within a right-of-way shared with conventional passenger railroad lines. Stations located within the shared corridors may need to accommodate both conventional passenger and high-speed trains.

This technical memorandum presents design guidance for high-speed train station platforms in order to advance the design of alignment and stations, promote efficient train operations, passenger safety, and meet applicable regulatory requirements. This document establishes station platform design requirements for geometric elements, clearance elements, and functional elements such as drainage provisions for platform facilities.

High-speed train station facilities in current operation were considered in the development of the platform design criteria for the CHSTP. Where appropriate, this memorandum presents the current design practices in Europe and Asia for reference.

The programmatic and functional requirements for station platforms such as the type and number of patron facilities to be provided on the platforms are addressed in a separate document.

1.0 INTRODUCTION

1.1 PURPOSE OF TECHNICAL MEMORANDUM

The purpose of this technical memorandum is to define station platform design criteria that establish consistency and promote safe and efficient operations for high-speed rail train service. This memorandum presents data relating to the design of passenger platforms, dimensions for high-speed train platforms, including length, height, platform edge to train gap, and platform curvature. It is based on current high-speed rail systems in Europe and Asia, and Federal and State codes, regulations, and guidelines.

1.2 STATEMENT OF TECHNICAL ISSUE

This document will assess and recommend the following criteria for the high-speed train passenger boarding platforms:

- Platform Length
- Platform Width
- Platform Cross Slope
- Platform Longitudinal Slope
- Platform Curvature
- Platform Height above Rail
- Track Centerline to Platform Dimensions
- Platform Edge to Train Gap
- Platform Drainage
- Setback of Obstructions from Platform Edge
- Under Platform Passenger Refuge Area
- Platforms Adjacent to Through Tracks

Where high-speed train stations may share operations with conventional passenger railroads, high-speed train platforms will be dedicated for high-speed train operations.

It is recognized that platform design must accommodate passenger movement, operational equipment, access and circulation (including stairs, escalators, elevators, elevator security, signage, etc.), and delivery of supplies and removal of trash. Guidance on station platform operational requirements, furnishing, and amenities is provided in Technical Memorandum 2.2.2 – Station Program Design Guidelines.

1.3 GENERAL INFORMATION

1.3.1 Definition of Terms

The following technical terms and acronyms used in this document have specific connotations with regard to California High-Speed Train system.

Alignment:	The horizontal and vertical route of the high-speed rail guideway.
Americans with Disabilities Act (ADA):	Federal regulation establishing legal requirements for accessibility. The Act prohibits discrimination on the basis of disability in employment, State and local government, public accommodations, commercial facilities, transportation, and telecommunications.
At-Grade:	At-ground surface level; used to describe roadways, river crossings, and track alignments.
Authority	California High-Speed Rail Authority

Center Island Platform:	Single boarding platform that services tracks on each side of the platform.
Dedicated Corridor:	Segment along the CHSTP alignment where high-speed trains operate on tracks that are exclusive of other conventional passenger or freight railroads.
Design Criteria:	The Direction for design of the system. The Design Criteria consist of mandatory items in the Design Standards and preferred items in the Design Guidelines.
Design Guidelines:	Provide a preferred but not necessarily required direction for a particular design feature. Guidelines are designated with the word SHOULD.
Design Standard:	The design standards presented in this document will normally be described using three terms: Desirable: The standard which shall be equaled or exceeded where there are no constraints on the alignment. Desirable horizontal and vertical standards may be used in any combination. Minimum/Maximum: The standard which shall be equaled or exceeded where constraints on alignment make a Desirable standard unobtainable or significantly more expensive than Minimum/Maximum standards. Even if a Desirable standard is not obtainable, it shall be approached as nearly as practical. Exceptional: The standard which shall be achieved at the absolute minimum and only where Minimum standards are either unobtainable or exorbitantly expensive. Even if Minimum standards are not obtainable, they shall be approached as nearly as practical. An approved design variance is required for the use of an Exceptional standard.
Design Standards:	Indicate a required direction for a particular design feature. Language relating to standards will include the word SHALL. The designer SHALL obtain written approval for any deviation from the standard.
Desirable:	The standard which shall be equaled or exceeded where there are no constraints on the alignment. Desirable horizontal and vertical standards may be used in any combination.
Exceptional	The standard which shall be achieved at the absolute minimum and only where Minimum/Maximum standards are either unobtainable or exorbitantly expensive. Even if Minimum/Maximum standards are not obtainable, they shall be approached as nearly as practical. An approved design variance is required for the use of an Exceptional standard.
Grade, Gradient:	The slope of changes in elevation, defined in percentage, as feet of rise in 100 feet. Sometimes defined in European publication as millimeters of rise in one meter, in which case it is normally written as o/oo.

Grade-Separated:	At different elevations; on separate levels.
High-Speed Main Tracks:	Tracks used exclusively for the operation of high-speed trains.
Intermediate Station:	A train station that will be between two other previously planned or currently operating stations.
Main Track	Those tracks of the railroad, exclusive of switch tracks, yards, and terminals. Main tracks have track circuits and all movements are protected by the ATC system.
Minimum/Maximum:	The standard which shall be equaled or exceeded where constraints make a Desirable standard unobtainable or significantly more expensive than Minimum/Maximum standards. Even if a Desirable standard is not obtainable, it shall be approached as nearly as practical.
OCS Pole:	Vertical structural element supporting the overhead contact system equipment, including auxiliary wires.
Outboard Platforms:	Side boarding platforms located directly opposite one another, each serving one track.
Overhead Contact System (OCS):	It comprises of: 1. The aerial supply system that delivers 2X25 kV traction power from substations to the pantographs of high-speed electric trains, comprising messenger (catenary) and contact wires, their associated supports and structures (including poles and foundations), manually and/or motor operated isolators, insulators, neutral-sections, auto-tensioning devices, and other overhead line hardware and fittings. 2. The traction return and grounding system by which traction current is returned from the wheel-sets of traction units to substations, and the means of grounding for the electrified railway track, comprising the running rails, negative feeders, aerial static wires (and buried ground conductors), together with all return current bonding and grounding interconnections.
Passing Track:	Track connected to the main tracks on both ends and allowing to stop a train for commercial reasons (in station for example), for operating purposes (in order to deal with delayed train or train with technical incident but also to allow train overtaking).
Rolling Stock:	Wheeled railway vehicles.
Shared Use Corridor:	Segment along the alignment where high-speed trains operate in or adjacent to right-of-way with conventional railroads, i.e. Caltrain, MetroLink, and Amtrak.
Shared Use Track:	Segment along the alignment where high-speed trains may operate with other passenger railroads on the same track.
Spiral:	Curve of variable radius used to connect a straight section of track with the radius of the body of the curve. Sometimes called a Transition or a Transition Spiral in European publications.

Station:	Areas within a station building envelope.
Superelevation:	The difference in elevation between the outside rail of the curve and the inside rail of the curve measured between the highest point on each rail head. Normally called Cant in European publications.
Track Centerline:	The line equidistant between the inside faces of the rail heads of a track.
Track Centers:	Distance between adjacent track centerlines.

Acronyms

ADA	Americans with Disabilities Act (Federal)
ADAAG	ADA Accessibility Guidelines for Buildings and Facilities
ANSI	American National Standards Institute
AREMA	American Railway Engineering and Maintenance-of-Way Association
ATO	Automatic Train Operation
CFR	Code of Federal Regulations
CHSTP	California High-Speed Train Project
CPUC	California Public Utilities Commission
DOT	Department of Transportation (Federal)
DSA	Division of State Architect, Department of General Services (State)
FRA	Federal Railroad Administration
GO	General Order
mph	Miles per hour
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
OCS	Overhead Contact System
TM	Technical Memorandum
TSI	Technical Specifications for Interoperability (European Union's)

1.3.2 Units

The California High-Speed Train Project (CHSTP) is based on U.S. Customary Units consistent with guidelines prepared by the California Department of Transportation (Caltrans) and defined by the National Institute of Standards and Technology (NIST). U.S. Customary Units are officially used in the United States, and are also known in the U.S. as “English” or “Imperial” units. In order to avoid confusion, all formal references to units of measure should be made in terms of U.S. Customary Units.

2.0 DESIGN STANDARDS AND GUIDELINES

2.1 GENERAL

Passenger platforms are an integral component of the station and cannot be designed as stand-alone elements. In developing the platform design, elements such as station track layout, signaling and catenary supports must be considered and arranged so as to not hinder circulation on the platforms.

It is anticipated that the specific rolling stock will not be selected prior to the completion of the 30% Design level. Accordingly, the platform design guidelines included in this document are intended to accommodate the operational needs of the CHSTP and the forecasted passenger volumes planned for the stations without precluding selection of any potential high-speed vehicle technologies that achieve the performance criteria defined for the project.

Platform design will be advanced with the assumption that the selected trainset will meet the CHSTP performance requirements and may be one of the following trains:

- Alstom – TGV (Resau)
- Rotem – KTX II
- Altsom – AGV
- Bombardier – Zefiro 380
- Japanese Consortia – Shinkansen Series N700
- Siemens – Velaro E/CN

Technical characteristics for these vehicles are presented in the Technical Memorandum 6.3. - Trainset Configuration Analysis and Recommendation. While multi-level (duplex) trains, including the Alstom TGV Duplex and the Shinkansen E4 were considered, as these do not satisfy level boarding requirements and their technical characteristics are not discussed in this document.

The platform design guidelines and associated design elements will be refined following vehicle selection since the technical criteria (length, floor height, location of the doors, etc.) vary according to the specific rolling stock.

2.2 LAWS AND CODES

Design criteria for the CHSTP are under development. When completed, a CHSTP Design Manual will present design standards and guidelines specifically for the construction and operation of high-speed railways based on international best practices and applicable state and federal requirements. Initial high-speed rail design criteria will be issued in technical memoranda that provide guidance and procedures to advance the preliminary design of project-specific elements. Criteria for design elements not specific to high-speed train operations will be governed by existing applicable codes, regulations, design standards and guidelines.

The CHSTP design standards and guidelines may differ from local jurisdictions' codes and standards. Because the Authority is an agency of the state government, development of buildings within the state's right-of-way should fall under the jurisdiction of the Division of the State Architect (DSA) and the State Fire Marshall along with input and coordination with local jurisdictions. Although state agency projects are not subject to local city or county codes, the high-speed train system is to provide for connection and integration with other passenger rail and transit services as well as the surrounding station area. In the case of such connections, consideration of local codes and other transit guidance will be appropriate. In the case of differing standards for work outside of the state-owned right-of-way, conflicts in design requirements will be resolved by using the higher standard or that is deemed as the most appropriate by the California High-Speed Rail Authority (Authority). The standard required for securing regulatory approval will be followed. In addition to the Division of the State Architect and the Office of the State Fire Marshall, approvals may also be required from the Army Corps of Engineers, California Coastal Commission, Caltrans, and other agencies and authorities at specific locations.

Applicable codes, rules, standards and guidelines may include:

- CPUC: California Public Utilities Commission
- 49 CFR 200 Series: FRA Railroad Safety Regulations
- California Building Code
- ADA and ADAAG: ADA Guidelines for Buildings and Facilities and Part IV DOT, 49 CFR Parts 27, 37 and 38
- The Manual for Railway Engineering of the American Railway Engineering and Maintenance-of-Way Association (AREMA Manual)
- ANSI 117.1 – American National Standards Institute Standard for Accessible Design for Persons with Disabilities
- National Electric Safety Code (NESC)
- NFPA 101: National Fire Protection Association's life safety code
- NFPA 130 (2010 Edition): National Fire Protection Association's fire protection and life safety requirements for underground, surface and elevated fixed guideway transit systems
- TSI: Technical Specifications for Interoperability for the Trans-European Transport Network.

2.3 APPLICABILITY TO CODE OF FEDERAL REGULATIONS

In accordance with CFR regulations that require that platform design meet the requirements of the Americans with Disabilities Act (ADA) Accessibility Guidelines, the CHSTP platforms will be designed to allow for level boarding of the trainsets.

2.4 POLICY CONSIDERATIONS AND DESIGN ASSUMPTIONS

Policy considerations can significantly influence the size and functionality of high-speed train platforms. Policy issues and potential approaches to addressing these issues are summarized in the following sections. In order to advance other elements of platform design, assumptions about policy considerations were necessary. Policy issues and design assumptions will require confirmation by the Authority and are subject to change.

2.4.1 Intermediate Station Tracks

Standard intermediate station configurations provide a station (stopping) track(s) that is adjacent to the platform and provides separation of the platform from the main (through) tracks. Right-of-way considerations may lead to circumstances where it is desirable to eliminate station tracks by siting station platforms on main tracks with operations allowing some trains to pass adjacent to passenger platform(s) without stopping. This document assumes that some stations will have through trains traveling on tracks adjacent to passenger platform(s) and addresses this arrangement and mitigations for potential impacts to patrons on the platform. Design considerations for pressure waves, noise, and induced air flow resulting from passage of trains at high speed are also addressed.

2.4.2 Platform Doors

Platform doors may be provided at platforms, particularly where trains pass platforms at high speed. Doors can serve multiple purposes, including accident reduction, especially where high-speed trains operate non-stop through the station, for passenger comfort, platform climate control, and for improved security by limiting access to tracks. Platform doors are used in some subways and airport transit systems but are uncommon in train stations. While Automatic Train Operation (ATO) is expected to be implemented on the high-speed train system regardless of whether platform edge doors are used, it is noted that platform edge doors effectively mandate the implementation of ATO.

Options for platform doors include:

- **Platform screen doors.** Full height barriers between the station floor and ceiling.
- **Platform edge doors.** Full height but do not reach the ceiling.
- **Platform safety gates or platform gate doors.** Gates approximately 3 feet high are used at some Shinkansen stations in Japan.
- **Platform safety rails.** Safety railings but no gates between platform and train.

For the purpose of this document, it is assumed that platform edge doors are not implemented in stations. Signage and tactile warning strip will be provided at edge of platform. Visual and audible warning systems will notify passengers of approaching trains and other train movements. At intermediate stations, platform tracks may be separate from tracks used by non-stop trains. All trains are assumed to stop at terminal stations.

Should physical, operational, or budgetary constraints result in a condition at a station where tracks adjacent to a platform may be used by high-speed, non-stop trains, the platforms will be equipped with appropriate equipment, infrastructure, or procedures to ensure safety when a non-stop train is passing through the station. These locations may use barriers, visual and/or audible warning systems, and/or operational procedures such as restricting passenger access to platforms except when needed for boarding of stopping trains.

The types of train movements occurring at each station are defined by the operating plan, which will be refined as the planning and design process progresses. Station planners and designers should keep apprised of the current operating plans for the Phase 1 and Full Build conditions in order to understand the operating requirements at specific stations.

2.4.3 Level Boarding

The Americans with Disabilities Act mandates that all new rail vehicles and platforms provide level boarding, or that “rail-to-platform height in new stations shall be coordinated with the floor height of new vehicles so that the vertical difference, measured when the vehicle is at rest, is within plus or minus 5/8 inch under normal passenger load conditions” (ADA Accessibility Guidelines, 10.3.1(9)). Once aboard a train, trains in some rail systems have steps which are needed to access some of the seats, especially in trains with two levels of seats (duplex trains). Duplex trains can provide greater passenger capacity than a single-level train, however circulation within the train is more complex and steps reduce the accessibility of many seats. For the purpose of this document, it is assumed that only single level, non-duplex passenger trains will be used in for high-speed train system in order to provide a level, step-free path from platforms to all train seats.

3.0 ASSESSMENT/ANALYSIS

3.1 BACKGROUND

Design standards for operating international high-speed train systems were reviewed along with the design criteria for station platforms used by Caltrain, Metrolink, and Amtrak since several stations will be served by both high-speed trains and conventional passenger trains. Comparison data for platform design criteria for these systems are presented in Table 3.2-1.

3.2 GEOMETRIC CONSIDERATIONS FOR STATION PLATFORMS

3.2.1 Horizontal Alignment

The station track between the entry turnout and the exit turnout on the main track shall be on a tangent at the platform, with a 6,000 ft total length centered symmetrically around the station in order to accommodate the braking distance for high-speed turnouts and to meet comfort high-speed train comfort criteria in acceleration and deceleration. See Technical Memorandum 2.1.3 - Turnouts and Station Tracks, Figures 6.3.1 and 6.3.2.

If the siting of a station along a horizontal curve is unavoidable, the horizontal curve should be to the largest practical radius. Spirals and superelevation within platform limits should be avoided. In the limiting case, the curvature shall not contribute to superelevation more than 2.33 inches. If curved platforms are used, it is desirable that the platform edge be convex, with the platform inside the arc of the curve, for the sake of visibility along the length of the train.

3.2.2 Longitudinal Profile

The longitudinal profile of station tracks is to be established on a flat level or as flat a level as practical in order to avoid drift of a parked trainset along the platform. The desirable longitudinal slope shall be level. The maximum longitudinal slope shall not exceed 0.25%.

3.2.3 Platform Configuration

There are two primary types of stations to consider for platform design: terminal stations and intermediate stations. Several operating scenarios warrant consideration with each station type. For example, there are intermediate stations where all trains will stop and intermediate stations where some trains stop and other trains will run through the station.

Considerations for the design of boarding platforms at terminal and intermediate stations include:

- Terminal Station: Dedicated platforms shall be used for a single type of train operation (high-speed trains or conventional passenger trains) as the requirements are different for each type. High-speed train platforms shall follow the design guidance described in this document. Platforms exclusively serving non high-speed trains shall follow the respective standards of Caltrain, Metrolink, and Amtrak as well as, ADA, CPUC, and other appropriate regulations, codes and standards.
- Intermediate station: There are dedicated high-speed train stations and stations located in corridors where both conventional trains and high-speed trains operate. Platforms at intermediate stations serving high-speed trains shall be designed to:
    - Maintain headways and allow efficient train operations by not slowing or stopping following trains when the leading train stops at an intermediate station.
    - Ensure the passenger safety as trains operate through the station area without stopping at the station.
    - Mitigate potential hazards associated with physical contact or induced airflow for patrons waiting on the platforms due to through train operating at high-speed through the station.
    - Mitigate the effect of the operating train noise which may startle people on the platform and may induce movements that could lead to an accident. Noise is a

source of potential discomfort for passenger waiting on the platform. Mitigation could include increasing separation between the platform and the noise source and installing noise barriers between the platform track and through track where trains are running at speed without stopping at platforms.

- o Protect passengers from objects that may be picked up by passing high-speed trains, including ballast, dust, or debris. Mitigation could include a station screen wall with a shared purpose as a noise barrier.

It is necessary to provide separate platform configurations for high-speed and conventional passenger trains at stations along shared corridors since the criteria of the vehicles (length, floor height, location of the doors, etc.) vary according to the type of rolling stock operating within the corridor.

These considerations lead to the following design guidelines:

1. Provide dedicated main tracks for trains that do not stop as well station tracks for trains stopping at station platforms, where practical.
2. Where practical, do not locate the platform adjacent to mainline high-speed tracks. If this is not possible, passenger access to platforms adjacent to tracks where trains may pass through stations without stopping may require mitigation, by either:
    - Limiting train speed on tracks adjacent to platforms;
    - Providing physical access control to the platform (such as doors or barriers) or similar devices limiting access to areas near the tracks.
    - Including audible and visual warning on platforms that provide advance notice of approaching trains (such systems will be provided at all stations whether platforms are adjacent to passing trains or not).
3. At intermediate stations where high-speed trains do not stop, an outboard platform with center running tracks is the desirable configuration for operational considerations.
4. Where practical, provide dedicated high-speed train platforms and conventional passenger rail platforms for stations within the shared use track corridors.

Typical track layouts at stations are illustrated in TM 2.1.3 Turnouts and Station Tracks. Side platform cross sections for elevated and at-grade stations are provided in Directive Drawings 2.2.4-C and 2.2.4-D. These drawings include the configuration of main and station tracks, clearances, basic vertical circulation and OCS pole placement.

Table 3.2-1: Summary Comparison of Platform Infrastructure Design Criteria

	CALTRAIN		METROLINK		FRANCE / EUROPEAN HST		JAPAN HST		TAIWAN HST		CHINA HST(4)	
	Metric	Imperial	Metric	Imperial	Metric	Imperial	Metric	Imperial	Metric	Imperial	Metric	Imperial
Elevation above rail	0.20 m	7.9"	0.20 m	7.9"	0.55 m 0.76 m (1)	21.7" 29.9"	1.25 m	49.2"	1.25 m	49.2"	1.25 m	49.2"
Distance / track center line	1.72 m	5.6'	1.62 m	5.3'	1.655 m	5.4'	1.75 m	5.7'	1.75m 1.79m (3)	5.7' 5.9' (3)	1.75 m	5.7'
LENGTH												
Normal	213.4 m	700.0'	207.3 m	680.0'	400 m	1312.0'			420 m	1378.0'		
Extended plate	304.8 m	1,000.0'	259.0 m	850.0'	490 m	1608.0'						
Terminal stat	609.6 m	2,000.0'										
WIDTH												
▪ OUTBOARD					5.5 m	18.0'	5 m	16.4'	7 m	23.0'	7-9 m	23'–29.5'
Mini	4.88 m	16.0'	4.88 m	16.0'								
Preferred	6.10 m	20.0'										
▪ CENTRAL					7.5 m	25.0'	9 m	29.5'	9 m	29.5'	10-12.5 m	32.8'-41'
Mini	7.92 m	26.0'	7.87 m	25.0'								
Preferred	9.75 m	32.0'										
CROSS SLOPE												
Slope direction	Away from rail		Away from rail		Away from rail				Toward Rail			
Gradient	1% ≤G< 2%		1% ≤G< 2%		2 %				1%			

1. 91.5 cm height is only used in England and Northern Ireland
2. Neither European standards nor French standards have preferred or min/max width as the width is based on ridership forecast. Dimension given here are those of French eastern high-speed line opened in June 2007 for information.
3. 1.75 m distance is for stations where all trains stop. 1.79 m is for stations where there are through trains on a stopping track.
4. Chinese standards indicate that platform length is to be determined according to factors such as station character, platform type, passenger flow density, safety distance, and vertical circulation width. Platform width varies within the prescribed range based on the station size.

3.3 PLATFORM GEOMETRY

3.3.1 Usable Platform Length

The minimum usable platform length shall accommodate the longest consist of high-speed train rolling stock selected that can meet the CHSTP performance requirements (Section 2.1) and are expected to be in use at the start of revenue operations, with assumed trainsets of sixteen cars, as shown in Table 3.3-1. Additional platform length is necessary to allow sufficient operational distance on each side for coupling or to park two separated trains along the same platform.

Table 3.3-1: Summary of High-Speed Rolling Stock Lengths

Manufacturer	Trainset	Train Length
Alstom	TGV (Resau)	1312 ft (400 m)
Rotem	KTX-II	1319 ft (402 m)
Alstom	AGV	1312 ft (400 m)
Japanese Consortia	N700	1328 ft (404.7)m
Siemens	Velaro	1312 ft (400 m)

The EU Rolling Stock TSI defines a maximum train length and a corresponding minimum usable platform length:

> *"4.2.3.5 Maximum train length. The length of trains shall not exceed 400 m. A tolerance of 1 % is permissible in order to improve aerodynamic penetration of the front and rear of the train. To maximise access to the high-speed Trans European Network the maximum length of trains shall compatible with the usable length of platform specified in the High-Speed Infrastructure TSI 2006."*

This, along with the train lengths of existing rolling stock, results in an absolute minimum, or exceptional, platform length of 1315 feet. The minimum length of a platform along which a high-speed train will stop shall be 1370 feet, which is 40 feet (approximately one half of a car length) more than the exceptional platform length.

The desirable usable length of a platform along which a high-speed train will stop shall be 1410 ft, which is 80 feet (approximately one car length) more than the exceptional platform length. This platform length allows flexibility in operations as variation in trainset composition and potential temporary storage at station platforms.

In order to allow for potential future platform extension, it is recommended to design, wherever practical, the straight line along the platform as well as the track circuit on this track longer than the platform.

3.3.2 Platform Width

The platform width shall be sufficient to allow reception and movement for the maximum number of passengers based on projected ridership at each station. The platform width shall meet the requirements of NFPA 130 and ADA, including requirements for vertical access and circulation.

Platforms should provide room for people to: wait on the platform without overcrowding, alight the train without running into obstacles or other people, and be a safe distance from the platform edge and stopping and/or passing trains. Platforms at terminal stations may require additional platform width because of higher passenger loads, the concurrent boarding and alighting of multiple trains, and operational requirements.

Ridership forecasts and estimates of peak passenger load will be used to develop and assess appropriate widths. Methodology for determining peak passenger loads is provided in TM 2.2.2 Station Program Design Guidelines, Section 3.2.3 Peak Period Passengers.

Platforms should be sized according to ridership, circulation and egress requirements and based on experience with high-speed train stations in Europe and Asia (see comparative Table 3.2-1),. A platform with tracks on both sides should have a minimum width not less than 30 ft (9.0 m) and a platform with one track on one side shall have a minimum width not less than 20 ft (6.0 m). These dimensions should be examined in relation to the forecasted passenger volumes at each

station on an individual basis, as determined by the capacity needed at that location and the effect of any deviation from the recommended size on the operational performance of the rest of the system.

Based on high-speed train dynamic envelopes, aerodynamic effects and exceptional alignments at some stations, the tapering of platforms at some stations may be necessary. The taper of a platform is permitted beyond the limits of the public, usable length of the platform as required. Tapered area of the platform edge is recommended to protect the train from potential damage at each corner at both ends of the platform. The taper should be 10 feet long and gradually increase the distance from the platform edge to centerline of track by 0.5 foot. Taper shall be located outside the areas of trainset doors used by the public. Taper may be located beyond station platform itself and is not considered to be part of the usable platform length.

3.3.3 Platform Cross Slope

Platform cross slope shall be 1:100 minimum and 1:48 maximum away from the tracks to provide for drainage to provide a rolling slope away from the track for safety purposes. In case of center island platforms, provide drains along the center of the platform.

The cross slope maximum is defined by the Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines (July 23, 2004), Section 403.3 Accessible Routes, Slope.

3.3.4 Platform Longitudinal Slope

The platform longitudinal slope shall follow the rail longitudinal profile as the height of the platform has to be constant according to the rail. It is desirable for station tracks to be level and therefore it is desirable for the longitudinal profile of the platform to be level.

In no instance shall the longitudinal slope of the platform exceed 0.25%.

3.3.5 Platform Curvature

Amtrak and other U.S. transit agencies require that the station platforms have, in practical effect, zero curvature. As defined for ADA considerations, a platform with no curvature is the design criteria and any variance from that will require approval.

If the siting of a station along a horizontal curve is unavoidable, the horizontal curve shall be to the largest practical radius and spirals and superelevation within platform limits should be avoided. In the limiting case, the curvature shall not contribute to superelevation more than 2.33 inches. For the sake of visibility along the length of the train, it is desirable that the platform edge be convex so that the platform is located inside the arc of the curve. See Section 3.2.1 regarding limitation of superelevation.

3.3.6 Platform Height

Station platforms serving high-speed trains will be designed to allow for level boarding of the train in accordance with the requirements of the Americans with Disabilities (ADA) Accessibility Guidelines. Therefore, platform elevations will be specific to the equipment operated. Since the type of equipment is unknown, the platform height above rail is unknown as well. Accordingly, the standard height for the platform will be determined at a later stage of the design when specific information for the chosen trainsets has been selected.

Table 3.3.-2 presents trainsets that are anticipated to achieve the performance requirements.

Table 3.3-2: Summary of Single Level High-Speed Rolling Stock Floor Heights

Manufacturer	Trainset	Vehicle Floor Height
Rotem	KTX-II	45.47 in (1155 mm)
Alstom	AGV	45.47 in (1155 mm)
Bombardier	Zefiro 380	49.21 in (1250 mm)
Japanese Consortia	N700	51.18 in (1300 mm)
Siemens	Velaro	49.60 in (1260 mm)

The floor height of the single-level trainsets ranges from 45.47 inches to 51.18 inches above the top of rail. Therefore, the design criteria for preliminary design of platform height will be set to accommodate a trainset within this range. Once the rolling stock is selected, the platform elevation shall be set to be the same as the nominal car floor height at the doors of the vehicles. Refer to Section 3.3.8 regarding coordination of platform height with the floor height of new vehicles.

3.3.7 Track Centerline to Platform Edge

As defined in Technical Memorandum 1.1.10 – Structure Gauge, the widest trainset is the Shinkansen with 11.09 feet, making it necessary to clear 5.75 feet. For preliminary design, the nominal distance between the track center and the passenger platform edge shall be 5.75 feet. Once the rolling stock is selected, this dimension will be revised to one-half of the vehicle width plus the platform edge to train gap as defined in Section 3.3.8. CPUC General Order 26 – D, Section 3 establishes a minimum track centerline to platform edge of 7.5 feet for platforms four feet or less above the top of the rail. As this dimension will be less for all high-speed trains and some trains may have a vehicle floor height of more than four feet (Section 3.3.6), a CPUC waiver may be needed.

3.3.8 Platform Edge to Train Gap

The ADA requires a maximum horizontal gap, measured when the vehicle is at rest, of no greater than 3 inches (76.2 mm) between platform edge and train door sill.

The ADA requires that rail to platform height in new stations shall be coordinated with the floor height of new vehicles so that the vertical difference, measured when the vehicle is at rest, is within plus or minus ±5/8 in (16.0 mm) under normal passenger load conditions.

Exceptionally, existing vehicles operating in new stations may have a vertical difference with respect to the new platform within plus or minus ±1-1/2 inches (38.0 mm).

3.3.9 Setback of Obstructions from Platform Edge

In order to ensure adequate circulation space on the platform, visibility for system operators and patrons, and safe conditions for users, there shall be clear space between the edge of the platform and any obstructions, including elements such as sign posts, platform furniture, escalators, elevators, stairs, and columns, shall be set back from the platform edge. The setback of obstructions shall comply with NFPA and ADA requirements.

Obstructions can be classified as small, point obstructions (less than 3.3 feet in length parallel to tracks, such as masts, columns and sign posts) or large obstructions (greater than 3.3 feet in length parallel to tracks, point obstructions separated by less than 7.9 feet are a large obstruction). Based on experience with high-speed rail in Europe and Asia, the desirable setback of point obstructions from the platform should be based on ridership, circulation, and egress requirements and not less than 7.0 feet. Based on NFPA, under no circumstance should the setback of a point obstruction from the platform edge be less than 6.17 feet (NFPA 130 Section 5.5.6.3.1). The desirable setback of large obstructions from the platform shall be based on ridership, circulation, and egress requirements and not less than 9.0 feet.

This Technical Memorandum does not establish clearances from platform edge to obstructions which are located 8 feet or higher above platform. Sightlines for train operators, station operators and patrons waiting on the platform shall be not be hindered by canopies, signage, or other potential aerial obstructions.

3.3.10 Under Platform Refuge Area

In order to ensure platform safety, especially as trains will run frequently and at high-speeds, under platform refuge areas shall be provided at stations to provide emergency shelter.

A clear refuge space shall be provided under the platform edge at the track level. Refuge areas shall be a minimum 30 inches high and 30 inches deep along the entire length of the platform.

Exits from this space shall be provided at the platform ends. If platform gates or doors are provided, these areas are not required.

Shinkansen Interpretive Criteria require such a space for Japanese High Speed rail as does CPUC GO 143-B for light rail high level platforms.

3.4 DESIGN CONSIDERATIONS – SHARED USE CORRIDORS

At stations in shared-use corridors where high-speed trains and conventional passenger trains are expected to stop, platform design will need to accommodate both high-speed and regional rail platform requirements. Specific compatibility issues related to platform length, height, clearances, mini-high platforms, and door location markers must be considered. The preferred design is to provide a dedicated platform to serve each type of service.

3.5 DESIGN CONSIDERATIONS FOR PLATFORMS ADJACENT TO THROUGH TRACKS

At some stations in shared-use corridors, trains may pass at speeds up to 125 mph on tracks adjacent to a platform. People on station platforms in proximity to non-stop trains may feel the effects of pressure and airflow created by the passing train. This may create safety and passenger comfort issues for passengers on the high-speed rail platform as well as passengers on lower height commuter rail platforms.

3.5.1 Pressure Impacts

A pressure wave may negatively impact the eardrums and can be influenced by the train nose geometry and the person's distance from the train. "Assessment of Potential Aerodynamic Effects on Personnel and Equipment of High-Speed Train Operations" (FRA, 1999) concluded that for train speeds of up to 150 mph, a person 3.3 feet or greater from a passing train is not likely to feel significant pressure on their eardrums.

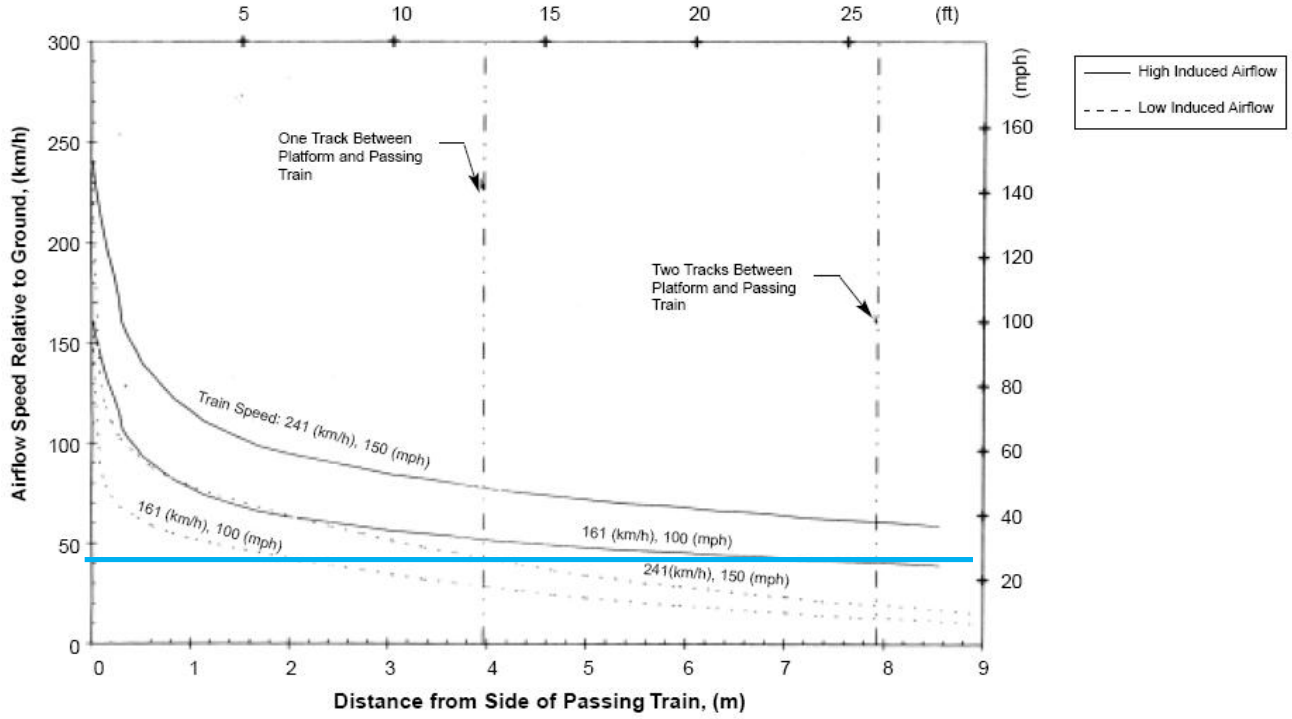
The pressure wave may also potentially impact the balance of the people standing on the platform. A person 2.36 feet from the train should experience a force similar to a rapid transit train during acceleration. Because this force acts for a short time, it may create an imbalance for some people.

3.5.2 Induced Airflow Impacts

A passing train induces an airflow with a velocity that decreases with increased distance from the train. The airflow speed can be very high close to the train but drops off sharply. Such airflow can impart forces on people or luggage close to the train or blow debris, such as gravel or dust. The maximum speed that a train passes a platform depends on the airflow speed which can be tolerated a distance away from the train.

In order to address the safety and comfort of passengers, British Rail established safety parameters for induced air velocities to which patrons and employees shall be exposed. For employees working on tracks, this is 38 mph and for members of the public, it is 25 mph. The literature review performed in "Assessment of Potential Aerodynamic Effects on Personnel and Equipment in Proximity to High-Speed Train Operations" (FRA, 1999) used previous research to determine induced airflows on platforms based on train speeds and train geometry. Figure 3.5.1 illustrates that, in order to meet the 25 mph British Rail standard, passengers must be set back about 13 feet from the platform edge if a train passes at 150 mph and about 7.5 feet if a train passes at 100 mph. It is assumed that high-speed trains will have a low induced airflow.

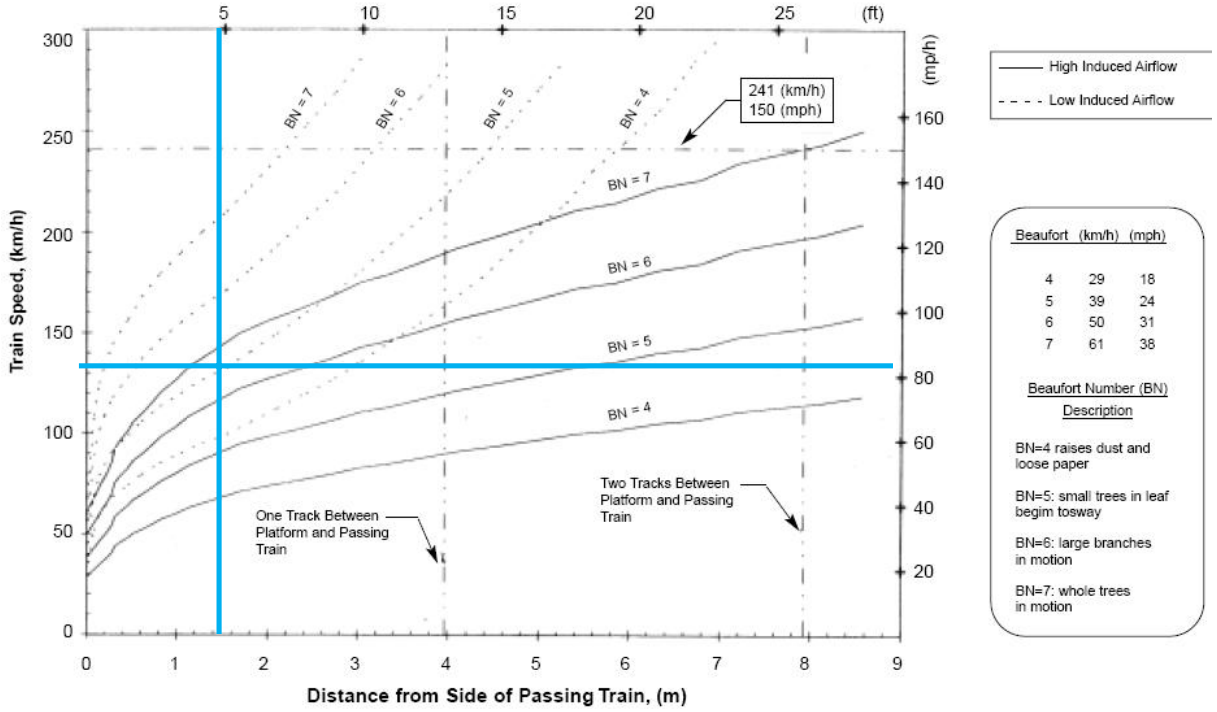
Figure 3.5.1: Induced Airflow from a Passing Train at Two Train Speeds and for Trains with high and with Low Induced Airflow Strengths



Source: Assessment of Potential Aerodynamic Effects on Personnel and Equipment in Proximity to High-Speed Train Operations. US Department of Transportation, Federal Railroad Administration, Office of Research and Development, Safety of High-Speed Ground Transportation Systems. (December 1999)

Another way of controlling induced airflow is to limit the train speed based on the proximity of platform occupants to a passing train and the level of induced airflow they should withstand. This is illustrated in Figure 3.5.2. For example, assuming a maximum induced airflow of 25 mph, a low induced airflow vehicle and 5 ft distance from the side of the passing train, the train speed would be limited to 82 mph.

Figure 3.5.2: Maximum Permissible Train Speed to Limit Induced Airflow



Source: Assessment of Potential Aerodynamic Effects on Personnel and Equipment in Proximity to High-Speed Train Operations. US Department of Transportation, Federal Railroad Administration, Office of Research and Development, Safety of High-Speed Ground Transportation Systems. (December 1999)

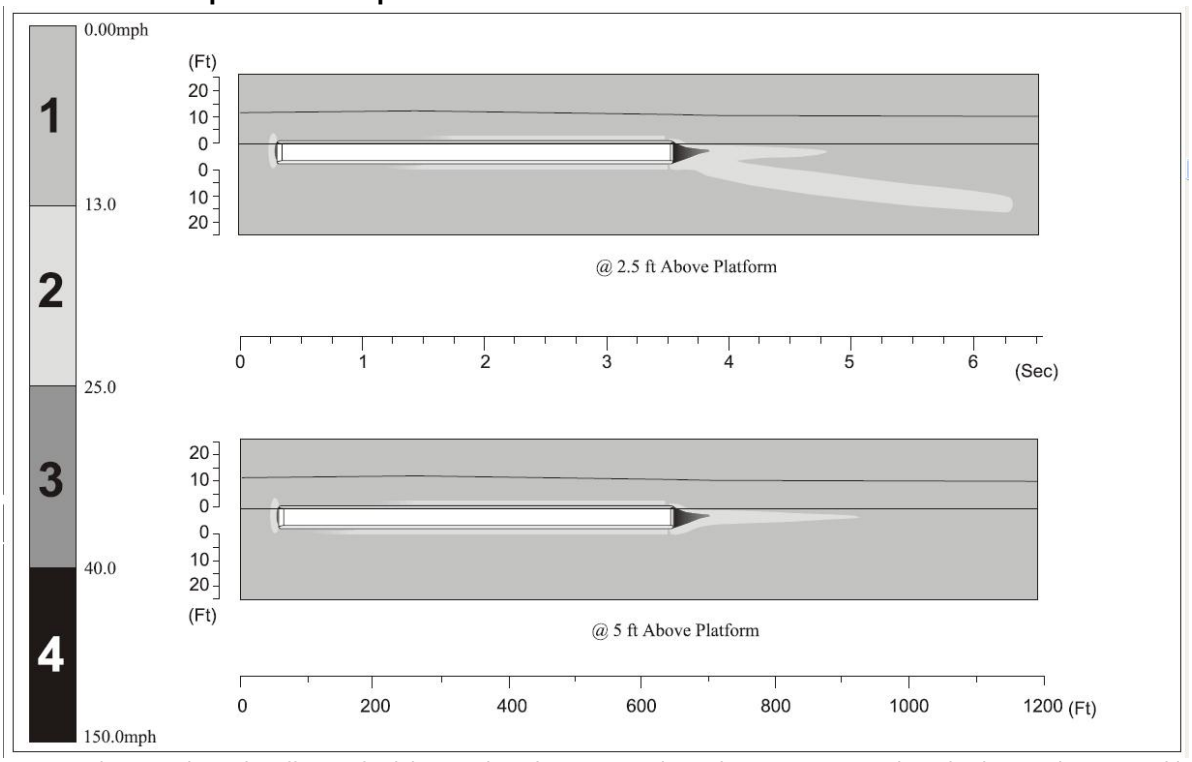
The study acknowledged the influence of train geometry on the strength of aerodynamic forces. In order to further investigate this, "The Aerodynamic Effects of High-Speed Trains on People and Property at Stations in the Northeast Corridor" (FRA, 1999) analyzed the aerodynamic effects of the Acela trainset passing a station platform by using the numerical analysis technique of computational fluid dynamics. Models were validated through the modeling and field measurements of existing Amfleet rail cars.

The modeling considered three scenarios: 1) a low-level platform with the Acela trainset; 2) a high-level platform with the Acela train; and 3) a high-level platform with the Acela trainset a track away from the platform. The first scenario may be used to evaluate the impact of high-speed train on the low level platforms of other operators in high-speed train shared use corridors. The second scenario may be used to evaluate the impact of high-speed train passing adjacent to high-speed train platforms without stopping.

The modeling of the high-level platform is shown in Figure 3.5.3. Induced airflow velocities are plotted at 2.5 and 5 ft about the platform to account for changes in effects that may be felt by luggage or children. The high-level platform analysis shows that the induced horizontal airflow on the platform is less than 25 mph and less than 13 mph more than 2 or 3 ft from the train. Fluctuation from this average airflow is small.

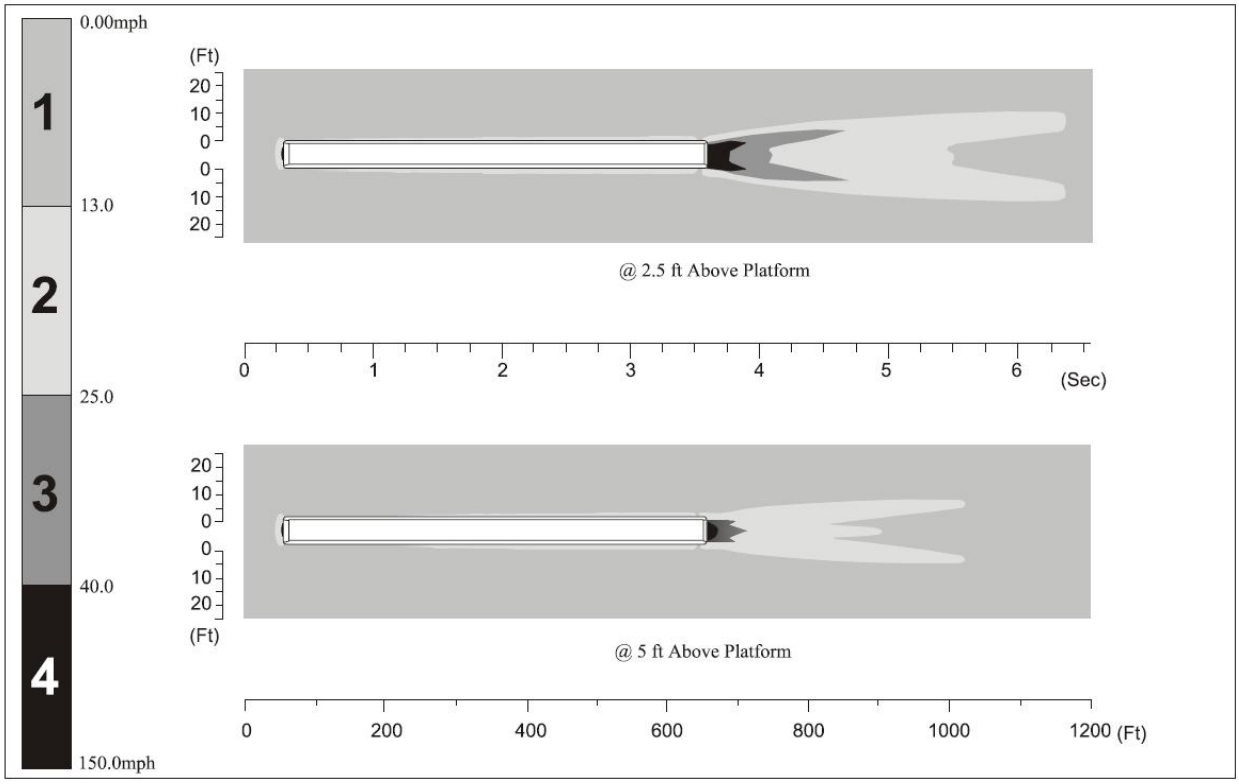
The modeling of the high-level platform is shown in Figure 3.5.4. Low-level platforms are subject to significantly more induced airflow than high level platforms. However, this airflow drops off quickly with distance. The low level platform analysis shows that the induced horizontal airflow on the platform is less than 13 mph about 10 ft away from the train. As the train will be separated from the low level platform by another track and at least 30 ft., induced airflow from the high-speed train should not impact patrons of other rail systems. Fluctuation from this average airflow is limited to a few feet from the train, therefore not impacting patrons standing on a low level platform a track away from the moving train.

Figure 3.5.3: Horizontal Mean Induced Airflow Velocity - High-Level Platform - Acela Trainset Speed = 150 mph



Source: The Aerodynamic Effects of High-Speed Trains on People and Property at Stations in the Northeast Corridor. US Department of Transportation, Federal Railroad Administration, Office of Research and Development, Safety of High-Speed Ground Transportation Systems. (November 1999)

Figure 3.5.4: Horizontal Mean Induced Airflow Velocity - Low-Level Platform - Acela Trainset Speed = 150mph



Source: The Aerodynamic Effects of High-Speed Trains on People and Property at Stations in the Northeast Corridor. US Department of Transportation, Federal Railroad Administration, Office of Research and Development, Safety of High-Speed Ground Transportation Systems. (November 1999)

In Germany, between Berlin and Hamburg trains pass station platforms at over 140 mph. At these stations, Deutsch Bahn's normal "danger zone" for passengers on the platform was extended from 9.85 feet from the centerline to 12.1 feet. The normal tactile and visual marking of this area was deemed insufficient and warning announcements, signage, visual marking and partial fencing of the area were implemented.

Figure 3.5.5: Additional Deutsch Bahn Platform Safety Measures

Source: Deutsch Bahn, Railway Study Association Convention. July 5-9, 2009

While this research indicates that platforms should be safe for operation with trains passing adjacent to them at 150 mph, measures shall be taken to improve safety and comfort. Trains shall not pass on tracks adjacent to platforms at speeds greater than 125 mph, unless access to the platform is restricted when trains pass. At all stations, platform markings, audible and visual warning signs and signals shall be incorporated. This will include a marking on the platform for people to stand behind. It shall be positioned so that people standing behind it are at least 5 ft from the platform edge. Of this 5 ft zone, 3 ft shall not be used as part of the setback to large obstructions. For example, a minimum setback for stairs at a platform with trains that pass adjacent to it shall be 11.2 ft (8.2 ft +3 ft).

3.5.3 Protection Screen between Station Platform and Through Tracks

While FRA and TSI do not specifically require a noise wall barrier between station and through tracks, there are precedents on TGV, Taiwan, and Korean high-speed train system where such walls have been installed to mitigate the impact of noise, wind, induced airflow, or ballast scatter.

Provision shall be made for the installation of protection screens between through tracks and station platforms. This principally involves providing adequate space between main tracks and station tracks at intermediate stations. Provision of 25-feet between track centers will allow for the installation of protection screen, if required.

3.5.4 OCS Poles on Platforms

It is preferred that OCS poles and wires be located away from station platforms. If a wire is located above a station platform, the wire height will be set to meet the requirements of the National Electric Safety Code (NESC). Grounding requirements for platforms are included in TM 3.2.6 – Traction Electrification System Requirements for Grounding and Bonding and Protection against Electric Shock.

4.0 SUMMARY AND RECOMMENDATIONS

The recommended criteria for high-speed train station passenger platform geometric design are presented in Section 6.0.

5.0 SOURCE INFORMATION AND REFERENCES

1. The Manual for Railway Engineering of the American Railway Engineering and Maintenance-of-Way Association (AREMA Manual)
2. Federal Railroad Administration Code of Federal Regulations (CFR)
3. California Public Utilities Commission General Orders 26-D and 143-B
4. CHSTP Design Basis Document – California High-Speed Train Project – High-Speed Rail System Design Comparison
5. CHSTP Technical Memorandum TM 1.1.6 - Alignment Standards for Shared Use Corridors – Specific to LA to Anaheim
6. CHSTP Technical Memorandum 1.1.10 – Structure Gauge
7. CHSTP Technical Memorandum 1.1.18 – Design Variance Guidelines
8. CHSTP Technical Memorandum 2.2.2 – Station Program Design Guidelines
9. CHSTP Technical Memorandum 2.1.3 – Turnouts and Station Tracks
10. CHSTP Technical Memorandum 3.2.6 – Traction Electrification System Requirements for Grounding and Bonding and Protection against Electric Shock.
11. CHSTP System Requirements
12. Amtrak guidelines and present practices
13. Federal and State Orders guidelines and present practices
14. Americans with Disabilities Act (ADA) Accessibility Guidelines
15. Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines. July 23, 2004. United State Access Board. http://www.access-board.gov/ada-aba/final.pdf
16. Caltrain Design Criteria (April 15, 2007)
17. SCRRA Design Criteria Manual (January 2003)
18. European Technical Specification for Interoperability Relating to Infrastructure Subsystem of the Trans-European High-Speed Rail system (May 2002)
19. The Aerodynamic Effects of High-Speed Trains on People and Property at Stations in the Northeast Corridor. US Department of Transportation, Federal Railroad Administration, Office of Research and Development, Safety of High-Speed Ground Transportation Systems. (November 1999)
20. Assessment of Potential Aerodynamic Effects on Personnel and Equipment in Proximity to High-Speed Train Operations. US Department of Transportation, Federal Railroad Administration, Office of Research and Development, Safety of High-Speed Ground Transportation Systems. (December 1999)
21. Aerodynamic Effects of High-Speed Trains. US Department of Transportation, Federal Railroad Administration, Research Results. (June 2003)
22. Shinkansen Interpretive Criteria.
23. Ministry of Railway of the People's Republic of China. Provisional Regulations for railways design of newly constructed 300-350km/h Passenger Dedicated Line. March 2007.
24. Interface between Station Platforms, Track and Trains. Railway Group Standard. UK Rail Safety and Standards Board. (December 2007)
25. National Fire Protection Agency (NFPA) 130. Standard for Fixed Guideway Transit and Passenger Rail Systems. (2010 Edition)
26. California Public Utilities General Order 26-D
27. Railway Study Association Convention in Germany. July 5-9, 2009. Toby Rackliff.

6.0 DESIGN MANUAL CRITERIA

6.1 STATION PLATFORMS

These design guidelines apply to station platforms serving high-speed trains.

6.1.1 Platform Configuration

There are two primary types of stations to consider for platform design: terminal stations and intermediate stations. Several operating scenarios warrant consideration for each station type. For example, there are intermediate stations where all trains will stop and intermediate stations where some trains stop and other trains will run through the station.

Considerations for the design of boarding platforms at terminal and intermediate stations include:

- Terminal Station: Dedicated platforms shall be used for a single type of train operation (high-speed trains or conventional passenger trains) as the requirements are different for each type. High-speed train platforms shall follow the design guidance described in this document. Platforms exclusively serving non high-speed trains shall follow the applicable standards of Caltrain, Metrolink, and Amtrak as well as, ADA, CPUC, and other appropriate regulations, codes and standards.
- Intermediate station: There are dedicated high-speed train stations and stations located in corridors where both conventional trains and high-speed trains operate. Platforms at intermediate stations serving high-speed trains shall be designed to:
    - Maintain headways and allow efficient train operations by not slowing or stopping following trains when the leading train stops at an intermediate station.
    - Ensure the passenger safety as trains operate through the station area without stopping at the station.
    - Mitigate potential hazards associated with physical contact or induced airflow for patrons waiting on the platforms due to through train operating at high-speed through the station.
    - Mitigate the effect of the train noise which can startle people on the platform and may induce movements that could lead to a accident. Noise is a source of potential discomfort for passenger waiting on the platform. Mitigation could include increasing separation between the platform and the noise source and installing noise barriers between the platform track and through track where trains are running at speed without stopping at platforms.
    - Protect passengers from objects that may be picked up by passing high-speed trains, including ballast, dust, or debris. Mitigation could include a station screen wall with a shared purpose as a noise barrier.

It is necessary to provide separate platform configurations for high-speed and conventional passenger trains at stations along shared corridors since the criteria of the vehicles (length, floor height, location of the doors, etc.) vary according to the type of rolling stock operating within the corridor.

These considerations lead to the following design guidelines:

1. Provide dedicated main tracks for through trains as well station tracks for trains stopping at station platforms, wherever practical.
2. Where practical, do not locate the platform adjacent to mainline high-speed tracks. If this is not possible, passenger access to platforms close to tracks where trains may pass through stations without stopping may require mitigation, by either:
    - Limiting train speed on tracks adjacent to platforms;

- Providing physical access control to the platform (such as doors or barriers) or similar devices limiting access to areas near the tracks.
- Including audible and visual warning on platforms that provide advance notice of approaching trains. Warning systems will be provided at all stations whether platforms are adjacent to passing trains or not.

3. At intermediate stations where high-speed trains do not stop, an outboard platform with center running tracks is the desirable configuration for operational considerations.
4. Where practical, provide dedicated high-speed train platforms and conventional passenger rail platforms for stations within the shared use track corridors.

Typical track layouts at stations are illustrated in TM 2.1.3 Turnouts and Station Tracks. Side platform cross sections for elevated and at-grade stations are provided in Directive Drawings 2.2.4-C and 2.2.4-D. These drawings include typical arrangements for the main and station tracks, clearances, basic vertical circulation and OCS pole placement.

6.1.2 Usable Platform Length

The minimum usable platform length shall accommodate the longest consist of high-speed train rolling stock selected that can meet the CHSTP performance requirements. Once the rolling stock is selected, the platform length will be set in accordance with the rolling stock criteria.

The desirable usable length of a platform along which a high-speed train will stop shall be:

- Desirable: 1410 ft
- Minimum: 1370 ft
- Exceptional: 1315 ft

In order to allow for potential future platform extension, it is recommended to design tangent track beyond the platform.

6.1.3 Platform Width

Platform width shall meet the requirements of NFPA 130 and ADA. The platform width shall be sufficient to allow accessibility and movement for the maximum number of passengers based on projected ridership for the station.

Platform with tracks on both sides (center island platform)

- Desirable: According to ridership, circulation and egress requirements, and not less than:
- Minimum: 30.0 ft
- Exceptional: 25.0 ft

Platform with track on one side (outboard platform)

- Desirable: According to ridership, circulation, and egress requirements, and not less than:
- Minimum: 20.0 ft
- Exceptional: 18.0 ft

Based on high-speed train dynamic envelopes, aerodynamic effects and exceptional alignments at some stations, the tapering of platforms at some stations may be necessary. The taper of a platform is permitted beyond the limits of the public, usable length of the platform as required. Tapered area of the platform edge is required to protect side of train from damage from corner of platform at each end of the platform. Therefore a taper should be 10 foot long and gradually increase the distance from the platform edge to centerline of track by 0.5 foot. Taper shall be

located outside the areas of trainset doors used by the public. Taper may be located beyond station platform itself and is not considered to be part of the usable platform length.

6.1.4 Platform Cross Slope

The platform cross slope shall be away from the tracks to provide for drainage for the track structure and to provide a rolling slope away from the track for safety purpose. In case of use of center island platforms, drains shall be provided along the center of the platform. The maximum cross slope is an ADA requirement.

- Desirable: 1.0%
- Minimum: 1.0%
- Maximum: 2.1%
- Exceptional: 2.1%

6.1.5 Platform Longitudinal Slope

The platform longitudinal slope shall follow the longitudinal profile of the rail as drainage of the platform is provided by the cross slope of the platform. It is desirable for station tracks to be level. The longitudinal profile of the rail, and therefore the platform, shall not exceed:

- Desirable: 0.0%
- Maximum: 0.25%

6.1.6 Platform Curvature

Platforms serving high-speed trains shall be on a tangent alignment along the usable length of the platform. If siting of a station along a horizontal curve is unavoidable, the curve should be the largest possible radius and will be subject to the variance process. Spirals and superelevation within platform limits should be avoided. If curved platforms are used, it is desirable that the platform edge be convex, with the platform inside the arc of the curve, for the sake of visibility along the length of the train.

6.1.7 Platform Height above Rail

Station platforms serving high-speed trains will be designed to allow for level boarding of the train in accordance with the requirements of the Americans with Disabilities (ADA) Accessibility Guidelines. Platform elevations will be specific to the equipment operated. Since the type of equipment is unknown, the platform height above rail is unknown as well. Accordingly, the standard height for the platform will be determined at a later stage of the design when specific information for the chosen trainsets has been selected. Refer to Section 6.1.9 regarding coordination of platform height with the floor height of new vehicles.

The floor height of the single-level trainsets ranges from 45.47 inches to 51.18 inches above the top of rail. Therefore, the design criteria for preliminary design of platform height will be set to accommodate a trainset within this range. Once the rolling stock is selected, the platform elevation shall be set to be the same as the nominal car floor height at the doors of the vehicles.

6.1.8 Track Centerline to Platform Dimension

The dimension between the track center line and the passenger platform edge shall be: ½ width of vehicle + 2.75 inches. This allows for a plus or minus construction tolerance of 0.25 inch in regard to the 3 inch maximum gap per ADA requirements.

For preliminary design, the nominal distance between the track center and the passenger platform edge shall be 5’-9”.

Once the rolling stock is selected, the distance between the track center line and the platform edge will be set in accordance with the rolling stock criteria.

6.1.9 Platform Edge to Train Gap

a) Horizontal Gap

ADA requires a maximum horizontal gap, measured when the vehicle is at rest, of no greater than 3 inches (76.2 mm) between platform edge and train door sill. This dimension requires 3 inches clearance between station platform edge and door threshold.

b) Vertical Gap

The vertical gap between the train door threshold and the platform edge will be established when rolling stock criteria are known. The following information is provided for use as it may affect the alignment design prior to obtaining the vehicle information.

- Desirable: 0 in
- Maximum: ±5/8 in
- Exceptional: ±5/8 in

6.1.10 Setback of Obstructions from Edge of Platform

Obstructions on the platform, such as columns, walls, stairs, sign posts, shall be set back from the platform edge to allow for safe and efficient operation of the platform. Setbacks are dependent on the size of the obstruction. Poles supporting the overhead contact system shall not be located on station platforms.

Small point obstructions, less than 3.3 ft in length parallel to platform:

- Desirable: As required for ridership, circulation and egress, and not less than 7.0 ft
- Minimum: 6.5 ft
- Exceptional: 6.17 ft

Large obstructions (greater than 3.3 ft in length parallel to tracks, two small point obstructions separated by less than 8.0 ft are to be classified as a large obstructions):

- Desirable: As required for ridership, circulation and egress, and not less than 9.0 ft
- Minimum: 8.25 ft
- Exceptional: 8.0 ft

These design criteria do not establish clearances from platform edge to obstructions which are located 8 feet or higher above platform. Sightlines for train operators, station operators and patrons waiting on the platform shall be not be hindered by canopies, signage, or other potential aerial obstructions.

6.1.11 Under Platform Refuge Area

A clear refuge space shall be provided under the platform edge at the track level. Refuge areas shall be a minimum 30 inches high and 30 inches deep along the entire length of the platform. Exits from this space shall be provided at the platform ends.

6.1.12 Platforms Adjacent to Through Tracks

The speed of trains on tracks adjacent to station platforms shall not exceed 125 mph. If trains on tracks alongside station platforms are intended to operate without stopping, one of more of the following measures shall be provided:

- Passenger access to the platforms adjacent to the tracks shall only be permitted when a train is intended to stop.
- Physical access control to the platform (such as doors or barriers) or similar devices limiting access to areas near the tracks.
- Audible and visual warning on platforms that provide advance notice of approaching trains shall be provided at all stations.

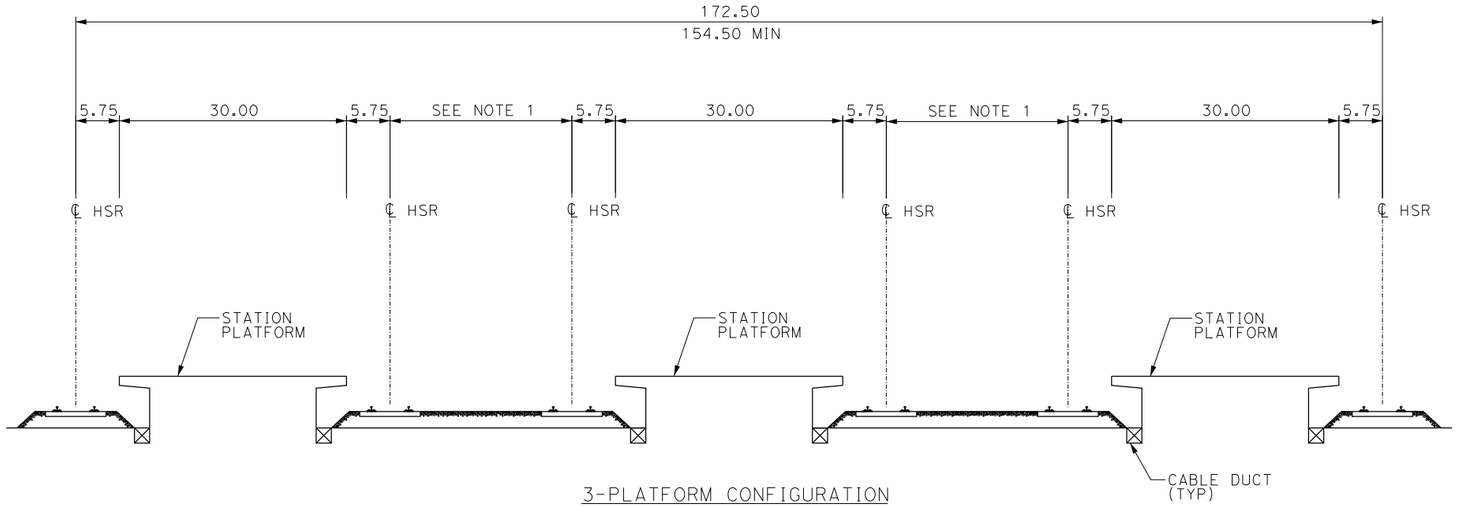
At stations accommodating through trains operating on tracks adjacent to the platform, platforms shall include a platform marking that indicates the location for waiting patrons to stand behind. It shall be positioned so that people standing behind the marking are 5.0 ft (minimum) from the platform edge. Where this zone is marked, 3.0 ft shall be added to the setback from platform edge to large obstructions so that minimum setback is 11.25 ft (Section 6.1.10).

6.1.13 Protection Screen between Station Platform and Through Tracks

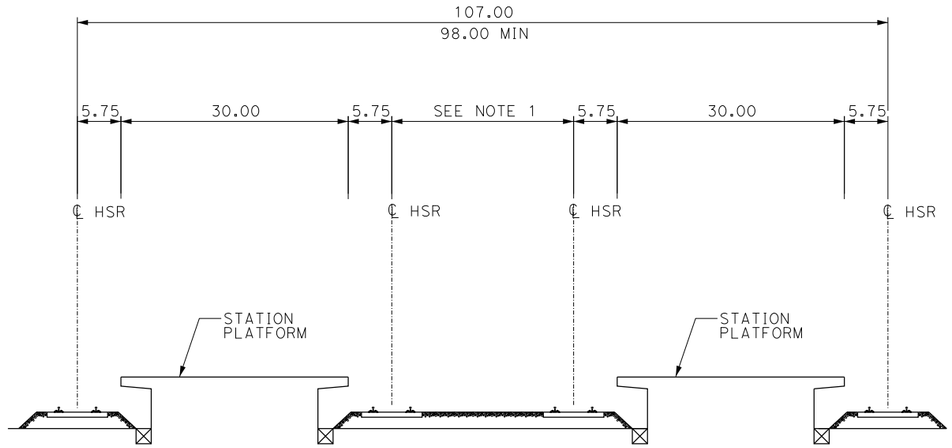
Provision shall be made for the installation of protection screens between through tracks and station platforms. This principally involves providing adequate space between main tracks and station tracks at intermediate stations. Provision of 25 feet between track centers will allow for the installation of protection screens, if required.

6.1.14 OCS Poles on Platforms

It is preferred that OCS poles and wires be located away from station platforms. If a wire is located above a station platform, the wire height will be set to meet the requirements of the National Electric Safety Code (NESC). Grounding requirements for platforms are included in TM 3.2.6 – Traction Electrification System Requirements for Grounding and Bonding and Protection against Electric Shock.



3-PLATFORM CONFIGURATION



2-PLATFORM CONFIGURATION

NOTES:

1. 24.00 W/ OCS POLE
   22.00 W/ OCS POLE (MIN)
   15.00 W/OUT OCS POLE

10 0 10 20
1"=10'

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY A. ANTONIO
DRAWN BY A. ANTONIO
CHECKED BY D. RULENS
IN CHARGE J. CHIRCO
DATE 07-07-09

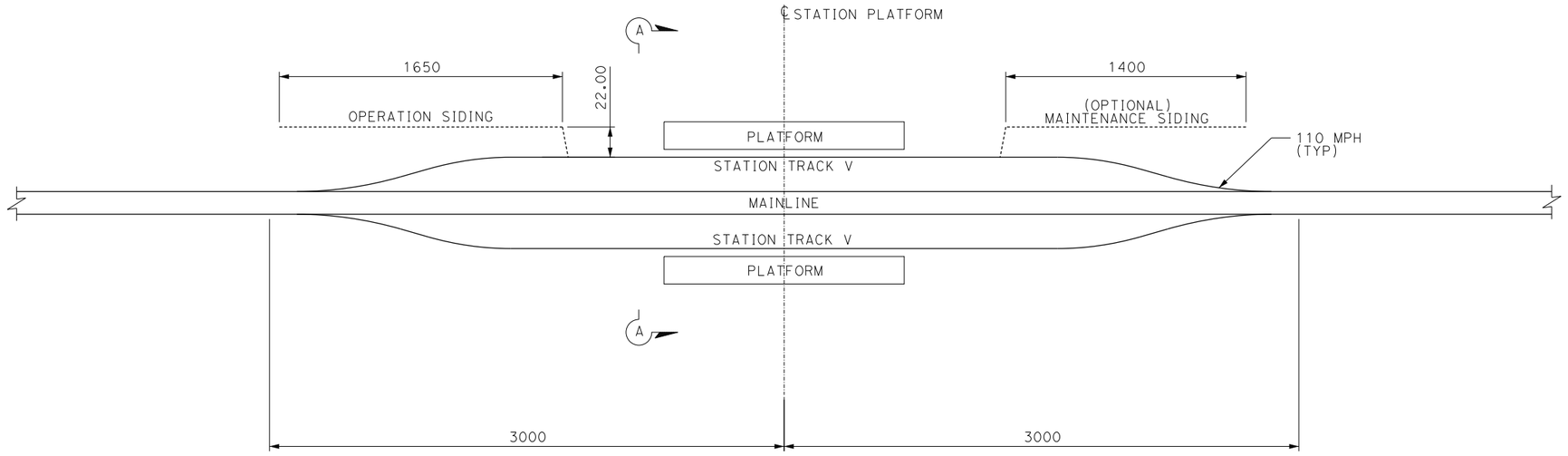
PB PARSONS BRINCKERHOFF

CALIFORNIA HIGH-SPEED RAIL AUTHORITY
FLY CALIFORNIA
Without ever leaving the ground.

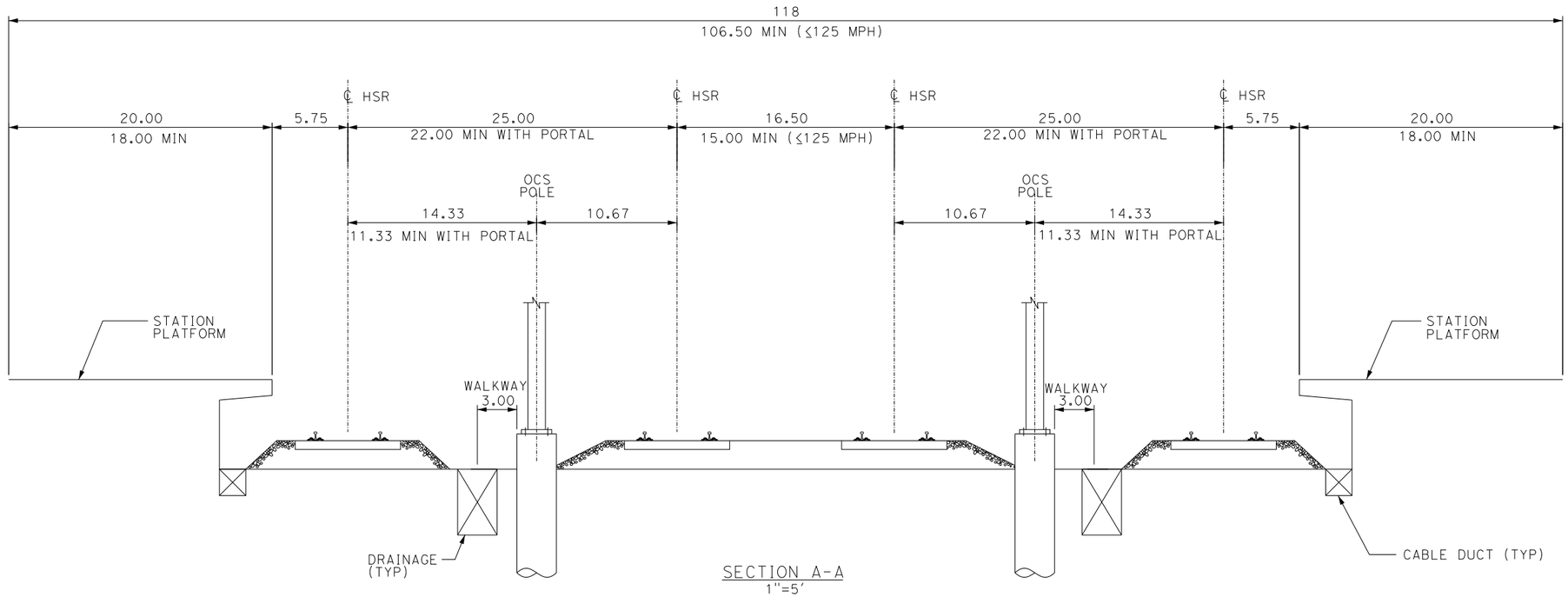
CALIFORNIA HIGH-SPEED TRAIN PROJECT

CENTER PLATFORM STATION
TYPICAL TRACK LAYOUT

CONTRACT NO. 13259
DRAWING NO. TM 2.2.4-A
SCALE 1"=10'-0"
SHEET NO.



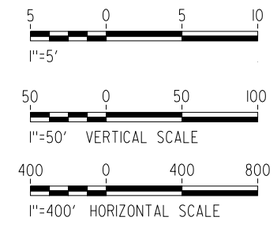
PLAN VIEW
H: 1"=400'
V: 1"=50'



SECTION A-A
1"=5'

NOTES:

1. 110 MPH DESIGN OF STATION TRACK, TURNOUTS, AND CROSSOVERS.
2. GRADE ≤ 0.25% MAX.
3. 3000' MINIMUM TOTAL REQUIRED FOR MAINTENANCE SIDINGS. SIDINGS CAN BE LOCATED IN ANY QUADRANT OF THE STATION.
4. PROVIDE UNIVERSAL CROSSOVERS BETWEEN MAIN TRACKS AT EACH OF STATION TRACKS.



REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY: G. HARRIS
DRAWN BY: A. ANTONIO
CHECKED BY: D. RULENS
IN CHARGE: J. CHIRCO
DATE: 07-29-09

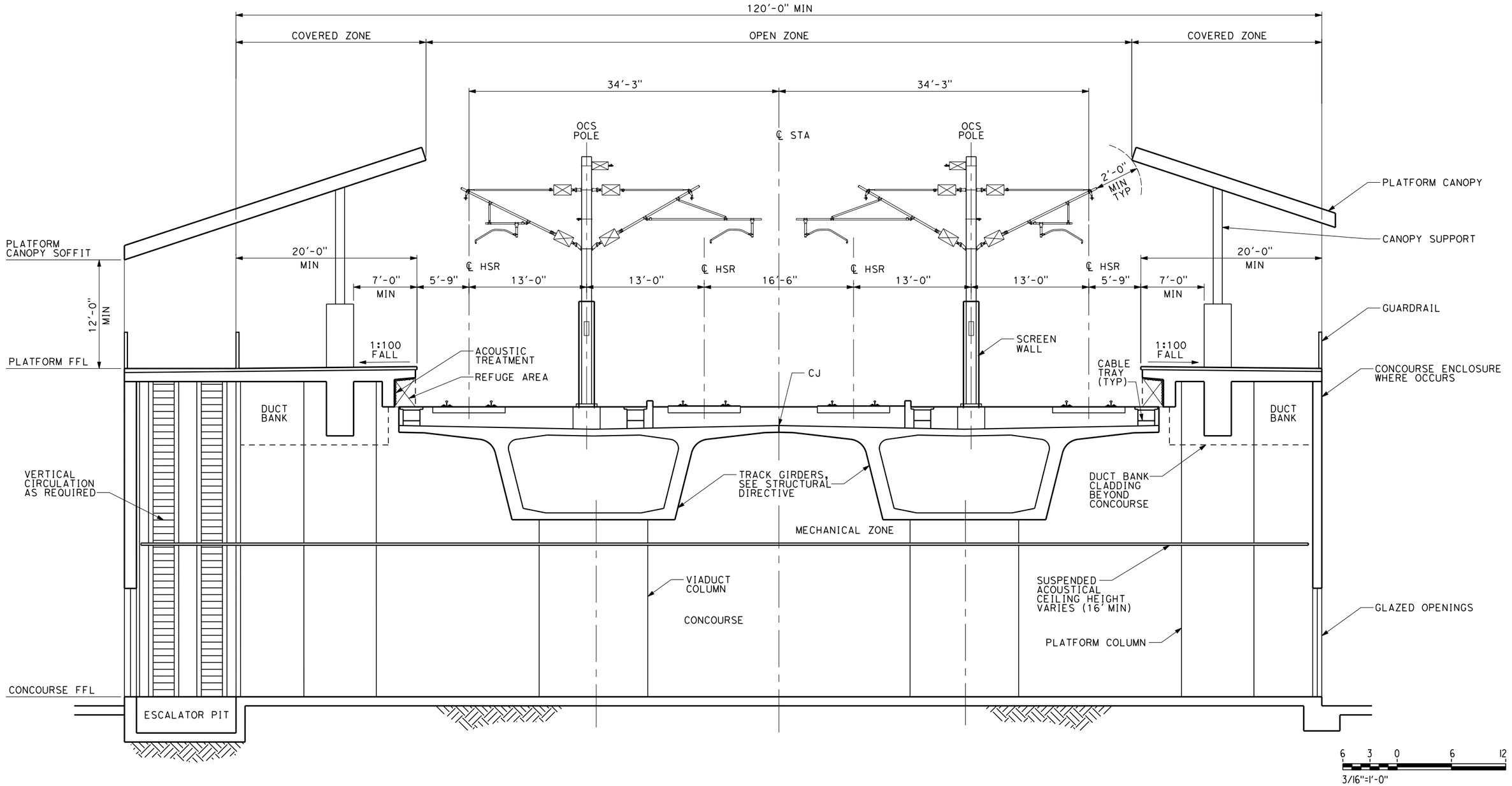
PB PARSONS BRINCKERHOFF

CALIFORNIA HIGH-SPEED RAIL AUTHORITY
FLY CALIFORNIA
Without ever leaving the ground.

CALIFORNIA HIGH-SPEED TRAIN PROJECT

INTERMEDIATE PLATFORM STATION
TYPICAL TRACK LAYOUT

CONTRACT NO. 13259
DRAWING NO. TM 2.2.4-B
SCALE AS SHOWN
SHEET NO.



REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY G. NEWGARD
DRAWN BY T. DOUNG
CHECKED BY R. SCHMEDES
IN CHARGE J. CHIRCO
DATE 06/04/10

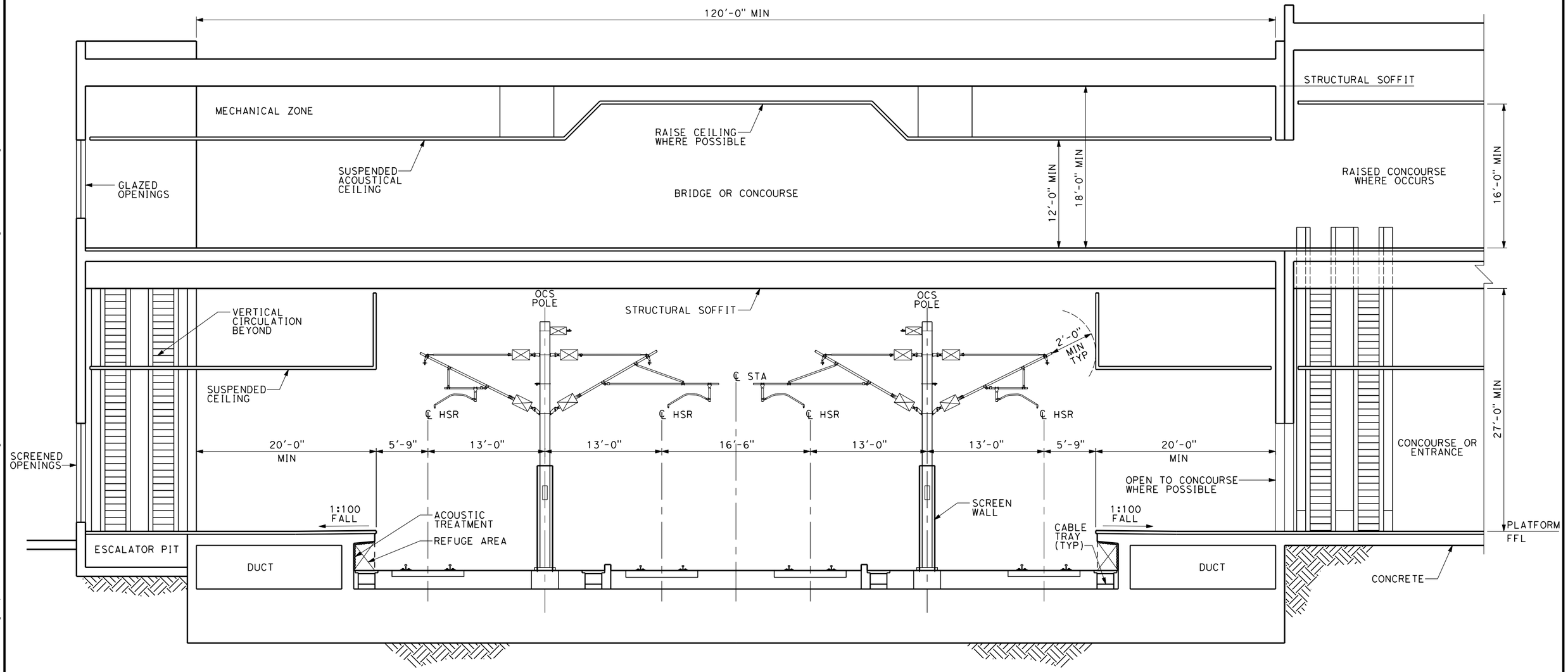
PB PARSONS BRINCKERHOFF

CALIFORNIA HIGH-SPEED RAIL AUTHORITY
FLY CALIFORNIA
Without ever leaving the ground.

CALIFORNIA HIGH-SPEED TRAIN PROJECT

ARCHITECTURAL DIRECTIVE DRAWINGS
ELEVATED SIDE PLATFORM STATION
CROSS SECTION

CONTRACT NO. 13259
DRAWING NO. TM 2.2.4-C
SCALE 3/16"=1'-0"
SHEET NO.



6 3 0 6 12

3/16"=1'-0"

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY G. NEWGARD
DRAWN BY T. DOUNG
CHECKED BY R. SCHMEDES
IN CHARGE J. CHIRCO
DATE 06/04/10

PB PARSONS BRINCKERHOFF

CALIFORNIA HIGH-SPEED RAIL AUTHORITY
FLYCALIFORNIA
Without ever leaving the ground.

CALIFORNIA HIGH-SPEED TRAIN PROJECT

ARCHITECTURAL DIRECTIVE DRAWINGS
AT-GRADE STATION
CROSS SECTION

CONTRACT NO. 13259
DRAWING NO. TM 2.2.4-D
SCALE 3/16"=1'-0"
SHEET NO.